rate in Scotland, particularly in the younger age-groups (45–64) (Fig. 16), may therefore be partly due to a late smoking effect. The present rates for carcinoma of the lung in Scotland, which are as high as or even higher than, those in England and Wales, may be due to smoking exerting a more rapidly lethal effect in this disease.

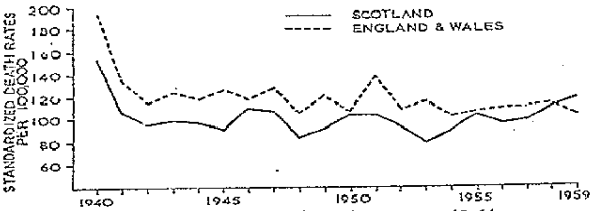


FIG. 16.—Bronchitis, males. Age-groups 45–64.


## Summary

Male/female ratios of death rates at various ages have been analysed in 10-year cohorts. The method has been used to compare the mortality in Scotland and in England and Wales from various diseases possibly connected with smoking. The results suggest that smoking has been exerting an effect longer in England and Wales than in Scotland. The recent rise in bronchitis mortality in younger age-groups in Scotland may be attributable to a smoking effect now beginning to exert an influence on the death rate in middle-aged men.


We are indebted to Professor Donald Reid, of the London School of Hygiene, for suggesting the method of this inquiry, and for much valuable help and constructive criticism during the course of the work. We are also glad to thank Mr. Stanley Sklaroff, of the Department of Public Health and Social Medicine, University of Edinburgh, for advice and helpful criticism; and Mrs. Maureen Richards and Mrs. Joan Valentine for secretarial help. The Registrar-General for Scotland kindly provided facilities for some of the work. We are grateful to the Royal Victoria Hospital Tuberculosis Trust for meeting some of the cost of the investigation.

## APPENDIX

The basic data were obtained from the *Annual Reports of the Registrar-General for Scotland*, the *Statistical Reviews for England and Wales*, and the *Census Reports* for Scotland and England and Wales.

The diseases included under the various headings in the investigation were as follows:

*Bronchitis.*—1870–1910, "bronchitis." 1920, *International Statistical Classification of Diseases* (I.C.) 89 and 90. 1930, I.C. 99. 1940, I.C. 106. 1950 and 1960, I.C. 500–502.

*Carcinoma of the Lung.*—No figures available before 1910. 1910, "carcinoma of the lung" in England and Wales: "carcinoma of larynx, lung, and pleura" in Scotland. 1920 and 1930, "carcinoma of larynx, lung, and pleura." 1940, I.C. 47. 1950 and 1960, I.C. 160–165.

*Respiratory Tuberculosis.*—1870–1910, "pulmonary tuberculosis." 1920, I.C.28 and 29. 1930, I.C. 31. 1940, I.C. 13. 1950 and 1960, I.C. 001–008.

*Pneumonia.*—1870–1910, "lobar pneumonia," "bronchopneumonia," "epidemic pneumonia," and "pneumonia not defined." 1920, I.C. 91 and 92. 1930, I.C. 100 and 101. 1940, I.C. 107–109. 1950 and 1960, I.C. 490–493.

*Ischaemic Heart Disease.*—1870 and 1880, no figures available for Scotland. 1870–1880, England and Wales: "angina pectoris." 1890–1910, "angina pectoris." 1920, I.C. 80. 1930, I.C. 89. 1940, I.C. 94. 1950 and 1960, I.C. 420.

*Peptic Ulcer.*—1870–1900, figures not available. 1910, "gastric ulcer." 1920, I.C. 102. 1930, I.C. 111. 1940, I.C. 117. 1950 and 1960, I.C. 540, 541 (and 542 in England and Wales).

*Cerebrovascular Accidents.*—1870 and 1880, "apoplexy." 1890 and 1900, "apoplexy, hemiplegia, brain paralysis." 1910, "cerebral haemorrhage, cerebral embolism"; "apoplexy and hemiplegia." 1920, I.C. 64 and 82a. 1930, I.C. 74. 1940, I.C. 83. 1950 and 1960, I.C. 331 and 332.

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# RELIGHTING OF CIGARETTES AND LUNG CANCER

BY


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The evidence for incriminating the smoking of cigarettes as a major factor in the aetiology of lung cancer is now overwhelming (Royal College of Physicians of London, 1962). There are, however, two facts which have not been satisfactorily explained: one is the finding that the disease is commoner in urban than in rural areas (Stocks, 1947); the other is the fact that the incidence, as deduced from deaths assigned to cancer of the lung, is much higher in Great Britain than in certain other countries—for example, United States of America—in which the cigarette consumption is apparently similar (Doll, Hill, Gray, and Parr, 1958). Further comparison between Great Britain and the U.S.A. in terms of the relative cigarette consumption and the eventual crude death rate 20 years later from cancer of the lung has shown that in Great Britain the latter is high, whereas in the U.S.A. it is low (Doll, 1958).

Hammond (1958) investigated on a comprehensive scale in the U.S.A. one aspect of smoking habits based on a study of over 4,000 cigarette ends, and found the average length to be 30.9 mm., whereas in a study of nearly 800 cigarette ends in Great Britain (Doll *et al.*, 1959) the average length was 18.7 mm.

We had gained the impression that patients in hospital suffering from lung cancer seemed particularly prone to the habit of putting out their cigarette half-way through and relighting the stumps. In the Manchester district this is known as "dimping" or "decking." It was planned to try to discover if a prolonged habit of the relighting of cigarettes was related to an increased hazard of contracting bronchial cancer, for if this were found to be the case it might constitute a factor influencing the international differences in incidence, on the assumption that in countries

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where it is customary for much larger cigarette stumps to be left by smokers the habit of relighting them might be expected to be less frequent.

### Details of the Investigation

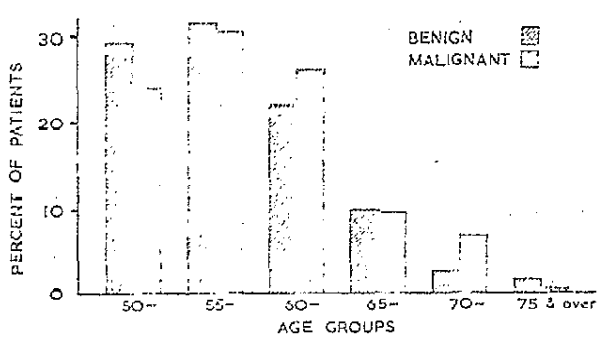
One thousand male smokers aged 50 and over attending the Manchester Chest Clinic and the thoracic surgical outpatient clinics in four centres in the neighbourhood of Manchester were seen by three of us and carefully questioned about their smoking habits over the years. For the sake of simplicity, to qualify as a smoker the patient had to have started the habit 20 years or more before being seen. Anyone who had given up smoking more than five years before his first attendance at the clinic was regarded as a non-smoker. Once accepted as a cigarette smoker on this basis the patient was asked about his smoking habits, with special reference to the average number of cigarettes consumed daily and the number of these which he had been in the habit of relighting. The smoking habits were recorded before reaching a diagnosis (except in a few instances where the diagnosis had already been established).

As well as the detailed smoking history, the age, main occupation, and social class (as classified by the Registrar-General of England and Wales) were recorded. A firm description of the occupation and social class could be applied in only 919 of the 1,000 patients.

Subsequently, after clinical, radiological, and laboratory investigations, each patient was accorded a diagnosis of either "lung cancer" (with the cell type when known) or "benign condition," and henceforward in the script and in the tables the term "benign" will indicate all conditions other than lung cancer.

Naturally, nearly all the patients had chest disease and there was a very high incidence of lung cancer, since so many of the patients had been referred specifically for a thoracic surgical opinion. It was by coincidence only that those with lung cancer formed exactly one-third of the group investigated (333 of the 1,000 subjects).

The ideal concept of such a study would have been comparison between a group with lung cancer and a similarly constituted control group drawn from the normal population. This was not a practical proposition, however, and the expedient alternative adopted appeared to be worth while, although it was realized that deductions to be drawn from the findings would thereby be more restricted. Despite the fact that the present survey is not a clinical trial in the statistical sense, tests of comparability of the benign and malignant groups are nevertheless possible. Two such tests are the respective age and social-class distributions (General Register Office, 1951), which are shown in the Chart and Table I. In both instances $\chi^2$ test of the differences between the relative distribution in the benign and cancer groups shows them not to be significant ($P>0.05$).




Age distribution of 1,000 male cigarette smokers.

TABLE I.—*Distribution by Social Class of 919 Patients Aged 50 and Over (81 Cases Excluded—Incurable or Assignment)*

| Social Class | Frequency Distribution (%) | |
|---|---|---|
| | Benign (602) | Cancer (317) |
| I | 0·5 | 0 |
| II | 3·6 | 4·2 |
| III | 61·8 | 60·4 |
| IV | 13·0 | 12·2 |
| V | 21·1 | 23·2 |

### Results of Analysis

The first basic fact to emerge from the survey was that when patients with benign conditions were compared with those having lung cancer it was found that of the 667 with benign conditions 39.1% were stated to be "relighters"—that is, relighting one or more cigarettes daily—as against 53.2% relighters among 333 men with lung cancer (Table II). The $\chi^2$ test showed the difference between these rates to be highly significant. The higher percentages of cancer cases among relighters when compared separately for each of the classes of cigarette consumption are also shown to be highly significant when the number smoked daily was fewer than 30; but the difference is only of borderline significance when smoking exceeded that amount.

Table III gives the relative percentages of benign conditions and cancer in patients shown in three categories—all smokers; non-relighters; relighters. Within each of these groups the percentage of patients with lung cancer is seen to increase as the number of cigarettes smoked daily increases. The significance values of the difference in cancer rates for non-relighters compared with relighters, both for individual cigarette consumption classes and for the totals, are, of course, the same as those entered at the foot of Table II.

From the figures presented in Tables II and III the possible carcinogenic effect of relighting cigarettes appears

TABLE II.—*Numbers of Men With and Without Cancer Divided by Number of Cigarettes Smoked and Habit of Relighting*

| Cigarettes Smoked Daily | No. of Smokers | | Relighters | | | |
|---|---|---|---|---|---|---|
| | | | Benign | | Cancer | |
| | Benign | Cancer | No. | % | No. | % |
| 1–14 | 198 | 56 | 86 | 43·4 | 39 | 69·6 |
| 15–29 | 331 | 159 | 135 | 40·8 | 90 | 56·6 |
| 30+ | 138 | 118 | 40 | 29·0 | 48 | 40·7 |
| Total | 667 | 333 | 261 | 39·1 | 177 | 53·2 |

Results of $\chi^2$ tests of the different rates for relighters in the benign and cancer groups:

| | $\chi^2$ | n | P |
|---|---|---|---|
| 1–14 .. | 11·911 .. | 1 .. | 0·0005 |
| 15–29 .. | 10·835 .. | 1 .. | 0·0009 |
| 30+ .. | 3·815 .. | 1 .. | <0·05 |
| Total .. | 17·669 .. | 1 .. | <0·0001 |

TABLE III.—*Percentage of Men With and Without Cancer Divided According to Number of Cigarettes Smoked and Habit of Relighting*

| Cigarettes Smoked Daily | All Smokers | | | Non-relighters | | | Relighters | | |
|---|---|---|---|---|---|---|---|---|---|
| | No. | % | | No. | % | | No. | % | |
| | | B. | C. | | B. | C. | | B. | C. |
| 1–14 | 254 | 78·0 | 22·0 | 129 | 86·8 | 13·2 | 125 | 68·8 | 31·2 |
| 15–29 | 490 | 67·6 | 32·4 | 265 | 74·0 | 26·0 | 225 | 60·0 | 40·0 |
| 30+ | 256 | 53·9 | 46·1 | 168 | 58·3 | 41·7 | 88 | 45·5 | 54·5 |
| Total | 1,000 | 66·7 | 33·3 | 562 | 72·2 | 27·8 | 438 | 59·6 | 40·4 |

Non-relighters = 1 lighting of each cigarette. Relighters = 2 lightings of each cigarette.
B. = Benign. C. = Cancer.

to be more pronounced in light smokers than in heavy smokers.

On the assumption that each relit cigarette was lit only twice it is possible to arrive at a figure giving the average number of times each day that each man went through the process of lighting a cigarette. Thus, a non-relighter who smoked 10 cigarettes daily had 10 lightings and a smoker of 10 daily who relit 5 of them had 15 lightings. In Table IV these "minimum lightings" are related to the numbers and percentages of patients with benign and malignant conditions.

Comparison of Tables III and IV shows a striking similarity in the percentage of patients with cancer in the three consumption-classes of non-relighters and those in the corresponding classes of "daily lightings of cigarettes." There is a suggestion—although this is speculation and not proof—that each lighting may be the equivalent, in possible carcinogenic effect, of a whole cigarette.

TABLE IV.—*Numbers of Men With and Without Cancer Divided by Number of Times Cigarettes Were Lit Daily*

| No. of Daily Lighting | No. of Patients | | | | |
|---|---|---|---|---|---|
| | Total | Benign | | Cancer | |
| | | No. | % | No. | % |
| 1–14 | 151 | 128 | 84·8 | 23 | 15·2 |
| 15–29 | 439 | 309 | 70·4 | 130 | 29·6 |
| 30+ | 410 | 230 | 56·1 | 180 | 43·9 |

Unfortunately there were not sufficient detailed histological diagnoses (only 49.6% of the total) to allow for any correlation between the smoking habits and the cell type.

## Discussion

A considerable amount of caution must always be exercised in the interpretation of analyses which derive from what people *say* as distinct from those which are based on incontrovertible evidence. In the present survey, therefore, the results revealed in the various analyses can be regarded only as *apparent* trends and not as indisputable facts. Nevertheless it seems reasonable to suppose, in the present instance, that such limitations are likely to apply to patients attending chest clinics irrespective of whether they have lung cancer or other respiratory disease

The group described as "smokers" was included in Table III to provide a yardstick against which the subgroups of non-relighters and relighters may be measured. Thus it serves to indicate that while—in common with the well-established statistical correlation of lung cancer with heavy and prolonged cigarette smoking—the percentage of lung cancer cases increases with the number of cigarettes smoked daily, this trend alone conceals in our sample the differences which emerge from separate investigation of the apparent effect of the relighting habit. It is conceivable that what is demonstrable in our group of patients may be true—even if in varying degree—for a wider population.

Thus the analyses appear to show that the habit of relighting cigarettes has an incremental effect on the correlation of the incidence of lung cancer with the number of cigarettes smoked daily over a long period of time. This apparent incremental effect seems to be strongest when the number of cigarettes smoked daily is relatively low (Table III). The intrinsic high risk incurred in heavy smoking may tend to swamp the effect of relighting cigarettes.

There is, furthermore, a strong suggestion that in the light and moderate smoker the act of relighting a cigarette in effect transfers the individual smoker to a higher daily consumption-class so far as the hazard of lung cancer is concerned. This effect could, of course, have been studied more profitably had the number of *times* individual cigarettes were relit been easily ascertainable, as there is a possibility that relighters in the fairly light or moderate smoking categories relight individual cigarettes on average a greater number of times than do those who smoke heavily.

In view of the fact that the incidence of lung cancer is much higher in large towns than in rural areas (Stocks, 1947) possible environmental influences should not be neglected in any study related to cigarette smoking. The subjects on whom our investigation is based were drawn almost exclusively from the large towns of South-East Lancashire; therefore no important environmental factor is believed to have affected the reported trends, as exposure to polluted atmosphere is likely to have been fairly uniform.

Some credence would appear to be given to the idea that the process of relighting a cigarette may be a factor in the aetiology of lung cancer.

## Summary

The smoking habits of 1,000 male smokers aged 50 and over have been studied. Two subgroups—one with lung cancer (333 subjects) and one with benign chest illnesses (667 subjects)—of patients attending chest clinics in the Manchester district have been compared with special reference to the habit of relighting cigarette stumps.

It was found that not only was the well-established association of lung cancer with heavy and prolonged cigarette smoking reflected in this group of smokers, but that also the habit of relighting cigarettes appeared to carry an incremental lung-cancer hazard. There was a suggestion, too, that this risk may be related to the number of daily lightings of cigarettes.

In tendering our thanks for assistance which has facilitated the completion of this report, we should, in particular, like to record the services of Miss D. Kirk, Miss S. Beaumont, and Mr. R. Schofield.

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A recent addition to the list of British Standards (B.S. 3622), "Surgeons' and Anaesthetists' Stools," aims at ensuring the physical comfort of the anaesthetist, whose role during operations is often exacting. The stools can also be used by surgeons when the nature of the operation permits, and for this reason two types of seat are included, one with a range of adjustment from 19 inches to 27, and the other from 26 inches to 34. The standard specifies an anti-static rubber seat pad and also allows for anti-static rubber feet to be fitted. Copies may be obtained from the B.S.I. Sales Branch, 2 Park Street, London W.1. (Price 3s. each; postage extra to non-subscribers.)